

MEMORANDUM

DATE:

TO: Leanne J. Tippet, Director
Air Pollution Control Program

THROUGH: Calvin Ku, Chief
Air Quality Analysis Section, APCP

Terry Rowles, Monitoring Unit Chief
Monitoring Data Analysis Unit, AQAS

FROM: Patricia Maliro, Research Analyst III
Monitoring Data Analysis Unit, AQAS

573-751-0750

SUBJECT: Data analysis of the Lead (Pb) Deposition in Soils around the
Herculaneum Area

The Monitoring Data Analysis Unit has updated the evaluation of the Pb deposition at Herculaneum in two separate Studies i.e., the Yard Soil Deposition Study and Soil Box Deposition Study. The update includes data that has been collected between the month of September 2003 to date. As previously mentioned, procedures of the analysis are in accordance with the U.S. Environmental Protection Agency "Guidance for Data Quality Assessment (EPA QA/G-9)."

Data Analysis Set-Up

The previous four groupings were maintained in the analysis of the yard soil data. They constituted 1) all houses within 0.25-mile distance from the smelter, 2) houses located at >0.25 but ≤ 0.50 miles, 3) houses located at >0.50 but ≤ 0.75 miles, and 4) houses located at >0.75 but ≤ 1.0 mile. The grouping was based on the distances between the houses and the smelter. Table 1 illustrates the sampling locations for data analysis

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purposes. Note that additional sampling has been carried out at three houses within a quarter-mile since the last analysis. Still, all soil samples collected in front of the houses (Quads 1 and 2) have been analyzed separately from samples taken from the back of the houses (Quads 3 and 4). Easement data has not been included in the analysis.

Yard Soil Data

In general, Pb levels still show decreased levels with increasing distance from the smelter. The levels are particularly high at the houses within half a mile of the smelter (see Table 2). Time series plots of the yard soil data, Figures 1 through 8 indicate monthly Pb concentrations that remain on the upward trend at closest distances from the facility. Additionally, there is a relatively increase in Pb levels at locations over a half a mile away (Figure 6 and 8) especially at the back of the houses.

When tested for significance, the Pb trends in front of the houses still show levels that are substantially on the rise (see Mann-K¹ Comparability Test, Table 3). Different dynamics continue to be noticed at the back of the houses. In that, only the location closest to the facility (≤ 0.25 mile) shows concentrations that are significantly increasing (see also Mann-K¹, Significance Test).

When trends observed in front/back of the houses are compared across houses within sampling location (a grouping) only houses within a quarter-mile of the facility continue to show concentrations that are increasing significantly (Table 3, Mann-K² through Mann-K⁴). Pb trends at locations beyond a quarter-mile distance from the facility still remain unclear.

Results of regression analysis in Table 4 with the additional data indicate Pb levels that have equally increased significantly in the front and at the back of the houses within a quarter mile of the smelter. A monthly increase of about four (4) ppm is noted in those areas. All other locations still show level increases that are not significant.

As indicated in the earlier analysis this subsequent rate of increase should be viewed in the light of a relative few numbers of samples. The actual rate of increase over longer time-periods could be somewhat more or less.

Soil Box Data

Table 5 and Figure 9 of the soil box data still show Pb levels that have generally decreased with increasing distance. The Station location that is a little over a quarter of a mile shows a concentration that is five times higher than the Sherman location about a mile away. Also locations in close proximity to the primary and secondary haul roadways show concentrations that are high. For example, Pb concentration at the

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Joachim (690) location is almost twice as much as the Joachim (695) levels. The two sites are not far from each other except that '695' is not along the haul road.

Upward trends at 351 Station and 690 Joachim continue to be noticed with the additional data, Figures 10 and 11 show Pb levels that are still trending up. All other locations still show levels that are low and stable (Figures 12 through 19).

Mann-Kendall tests of the soil box data analysis this time indicate significant upward trends at the 812 Brown and 672 Main locations in addition to 351 Station and 690 Joachim (see Table 6). There is also a significant decrease in Pb deposition at 210 Glennon Heights, which is about a mile away. In general, there is a significant (upward) monotonic trend across all locations near a haul road (see Mann-K⁵ in Table 7). No general trend is noticed across all other locations. That is, the trend appears approximately stable over the sampling period. Note also that only the 351 Station location is within a quarter mile of the smelter. This location is consistent with the yard soils. We should not expect 690 Joachim or 812 Brown or 672 Main to have an increase but they do. As shown in Table 8, there is still not yet enough evidence that the rate of deposition is significant in the soil box study in spite of upward trends at some of the locations.

In conclusion, Pb deposition is shown to have increased in yards of houses within a quarter-a mile of the facility and at locations near a haul road. It is believed that further data will yield a more reliable estimation of the deposition rate.

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Attachments

Table 5: Summary of the Descriptive Statistics for the Soil Box Data

Soil Box Location	Number of Observations	Approx Distance (miles from Smelter)	Direction	Mean (ppm)	Standard Deviation	Minimum (ppm)	Maximum (ppm)
351 Station	12	0.19	W	177.4	117.8	24	406
812 Brown	11	0.34	NW	74.1	24.0	39	121
672 Main	11	0.39	NE	58.4	36.5	24	149
292 Park	11	0.53	N	52.1	12.8	32	66
690 Joachim	12	0.55	NW	75.3	40.5	24	154
695 Joachim	11	0.56	NW	49.0	8.5	35	65
407 Hill	11	0.65	N	42.3	6.3	34	54
422 Reservoir	11	0.81	NW	43.8	7.0	33	53
210 Glennon Heights	11	0.88	NW	24.1	6.3	17	35
434 Sherman	11	0.91	N	28.5	9.0	19	50

Table 6: Overall Trends in Soil Box Lead Data

Soil Box Location	Approx Distance (miles)	Direction from Smelter	Mann-Kendall Statistic (S)	Test of Significance
351 Station	0.19	W	35	0.00047*
812 Brown	0.34	NW	23	0.027*
672 Main	0.39	NE	31	.023*
292 Park	0.53	N	4	0.3810
690 Joachim	0.55	NW	44	.00005*
695 Joachim	0.56	NW	2	0.046
407 Hill	0.65	N	-11	0.190
422 Reservoir	0.81	NW	-5	0.364
210 Glennon Heights	0.88	NW	-20	.022*
434 Sherman	0.91	N	-9	0.240

*Significant at 5% Level of Significance

Table 7: Comparability of the Sampling Locations in Soil Box Study and Overall Trends
(Results of the Mann-Kendall Tests)

Tests & Orientation	Locations	Compared Distances (miles)	Group Comparability Test	Mann-Kendall Statistic (S)	Group Significance Test
Mann-K⁵ Locations near haul road	351 Station	0.19		27	
	690 Joachim	0.55		28	
	812 Brown	0.34		15	
	672 Main	0.39	-14.64	33	15.48*
Locations not near haul road	292 Park	0.53		5	
	695 Joachim	0.56		-1	
	210 Glennon Heights	0.88		-20	
	407 Hill	0.65		-1	
	434 Sherman	0.91		-6	
	422 Reservoir	0.81	1.074	13	0.749

Table 8: Estimated Slopes for the Soil Box Data

Soil Box Location	Intercept	Time-Monthly Coefficient	r ²
351 Station	49.097 {18.182}	18.692 {10.331}	0.29
812 Brown	41.100 {18.300}	4.300 {2.084}	0.35
672 Main	-8.395 {27.854}	8.261 {3.105}	0.47
292 Park	57.36 {12.033}	-1.345 {1.341}	0.01
690 Joachim	35.690 {33.501}	5.836 {3.733}	0.23
695 Joachim	53.428 {7.767}	-0.351 {0.866}	0.02
407 Hill	51.024 {6.111}	-1.997 {0.681}	0.21
422 Reservoir	51.421 {7.019}	-0.842 {0.782}	0.12
210 Glennon Heights	36.612 {5.145}	-1.445 {0.573}	0.44
434 Sherman	37.965 {9.052}	-1.039 {1.009}	0.12

*Significant at 5% Level of Significance

Fig 9: Soil Box Average Lead Concentrations

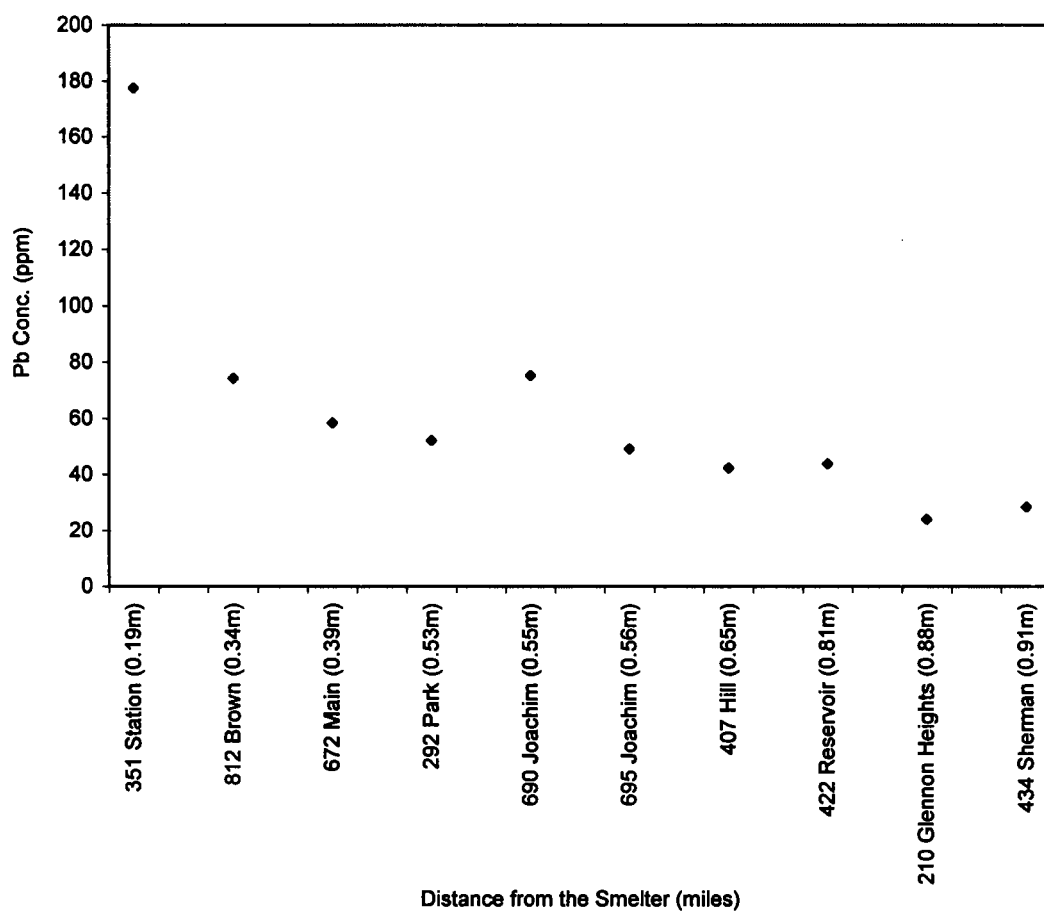


Fig 10 : Lead Concentration at 351 Station

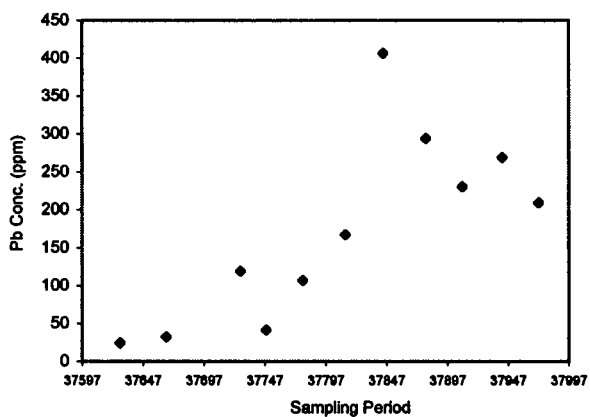


Fig 11 : Lead Concentration at 690 Joachim

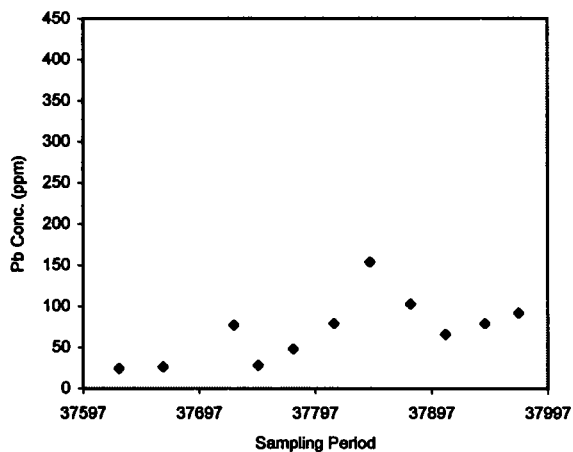


Fig 12 : Lead Concentration at 695 Joachim

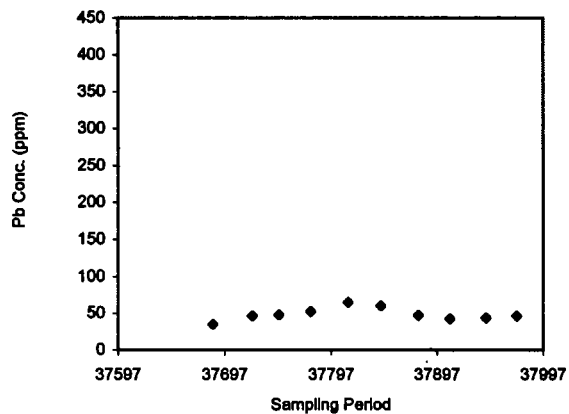


Fig 13 : Lead Concentration at 434 Sherman

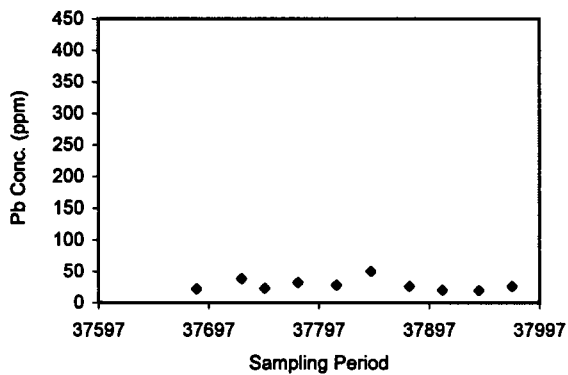


Fig 14: Lead Concentration at 812 Brown

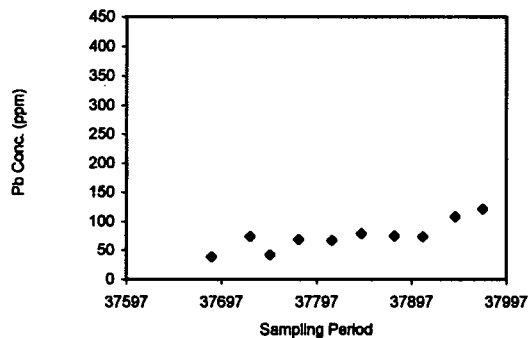
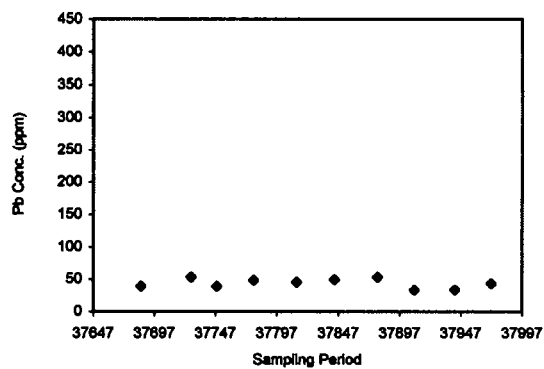


Fig 15 : Lead Concentration at 422 Reservoir



**Fig 16 : Lead Concentration at 210
Glennon Heights**

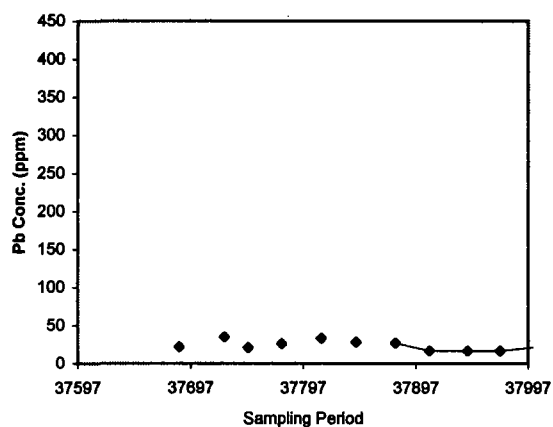


Fig 17: Lead Concentration at 672 Main

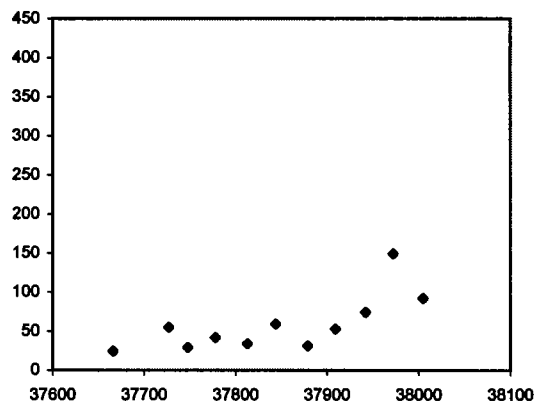


Fig 18 : Lead Concentration at 407 Hill

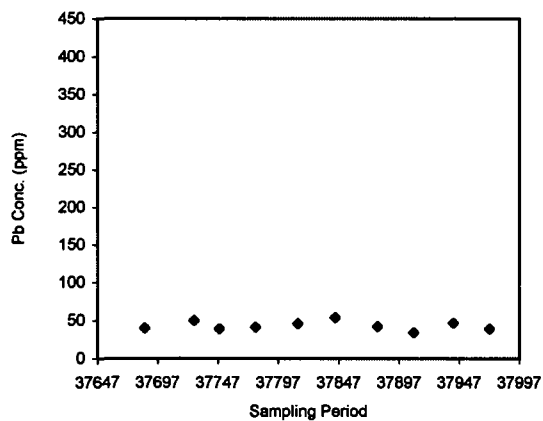


Fig 19: Lead Concentration at 292 Park

